

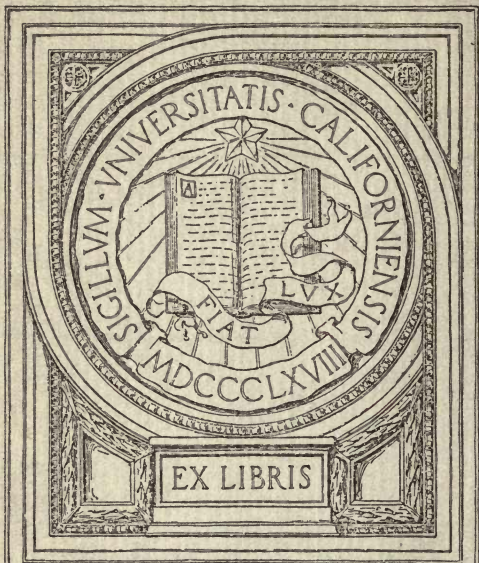
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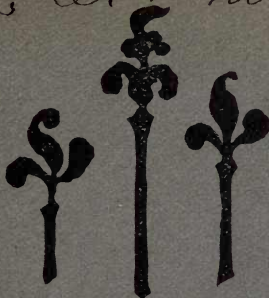
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Strawberry Culture

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Strawberry Culture

BY

M. CRAWFORD



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Guyahoga Falls, Ohio

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STRAWBERRY CULTURE

By M. Crawford



PRESS OF
DUFFY BROS. - CUYAHOGA FALLS

W. N. H.

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Preliminaries

Strawberries grow wild in nearly all localities, on all kinds of soil, and without any care at all. In the wild state they are neither large, productive nor profitable. Though the soil be virgin and the locality the most favorable, the plant's energies are fully taxed in the struggle with other growing things for its share of the food and moisture in the earth, and it is able to produce only a few small berries. When man enters the struggle, exterminates the competitors, furnishes more food and prevents the loss of the moisture, the result is different. When, in addition to this, he selects the best varieties and from these produces still better ones, the difference becomes still more marked. As the grower does his work well or otherwise the results are satisfactory or otherwise.

Before engaging in an undertaking whose outcome will depend so largely upon himself, a person may well take time for a little consideration. If he has land of various characters at his disposal, he should weigh the merits of different pieces in the light of his circumstances and aims. What he may consider the best piece of land on his farm, for strawberries, may have been in grass for several years. Would he better take his chances on having his plants destroyed by the grubs, which are likely to be in such land, or take another piece somewhat less favorable? Or perhaps his best strawberry land is wanted for some other valuable crop, like onions or celery, that requires soil of a particular character. It may take careful study to determine which crop shall have it. His land may be better adapted to growing late berries than early ones, and still early ones may be the most profitable in his market. It is well to deter-

mine also, as nearly as possible, how much time he can give to his strawberries, so that he may not undertake more than he can carry out well. In short, one who would become a grower of strawberries ought to consider in advance his land, his market, his own ability, energy and capital, and formulate his plans as definitely as possible, always remembering that strawberry growing implies the expenditure of a large amount of labor on a small piece of land with correspondingly large returns if success comes or heavy loss if through neglect, ignorance or other causes, failure results. It is too important a matter to plunge into heedlessly or drift into absentmindedly.

Habits of Growth

A strawberry plant makes its growth in one season, develops its blossom buds in the fall, remains dormant for a period in this climate, and produces its fruit the following spring and early summer. It grows whenever the temperature is much above the freezing point. If a warm time comes in the winter and continues for a few days, the plant makes some growth; and, if it is heavily mulched, this growth will be white and tender; and, if uncovered at that time and freezing weather follows, this blanched growth will be destroyed. Let us take a young plant in the early spring, plant it in a good place, care for it and watch its development. First we will remove all the leaves but one or two of the younger ones, shorten the roots to three inches, and plant it firmly in well-prepared soil with the crown level with the surface. The ground should be stirred around the plant just as if there was an acre of them. In a few days new leaves will start and growth will be quite rapid. A

little later blossom buds will be seen coming up from the center of the plant. We will cut these off, because the production of flowers and fruit would be too much of a tax on a newly set plant. We must continue to stir the ground frequently so as to keep a loose surface to retain the moisture in the soil. This frequent stirring incidentally prevents the growth of weeds. Cutting off the blossoms relieves the plant of a part of its work, and growth will be all the more rapid. If it is not allowed to spend its strength in producing blossoms and fruit, it will be the better able to send out runners, which it will immediately do. This, too, is a tax on its energies, and the careful grower will nip off the runner as soon as it makes its appearance. This prompt cutting off of blossoms and runners, and frequent stirring of the surface, especially if the soil is rich, will give the plant every chance to grow, and where will this growth take place? Mainly in the crown, which corresponds to the bulb of the lily or the body of the tree. Of course, the roots and leaves are being increased in numbers; the former to absorb food, in liquid form, from the soil, and the latter to spread it out over a large surface so as to let the water dry out of it—to boil it down. The object of all this is to store up substance in the stem or body of the plant to enable it to produce a crop of seed the next season. But seed is not the only means the plant has of multiplying its kind. It sends out runners from the axils of the leaves just as a grape vine sends out laterals. The more we do to promote growth, the more leaves and runners will be produced; and, if we let the plant have its own way, it will spend so much of its energy and vitality in the production of runners that it will be nearly exhausted at the end of the growing season, and in very poor shape to produce a crop the next season, or even to endure the winter. As fruit is our object, we will compel the plant to

store up its resources in the crown instead of wasting them in the production of runners that we don't want.

This instinct to produce runners is a characteristic of all the varieties we cultivate, but it seems to be stronger in some than in others. We can by withholding nitrogen diminish somewhat the number of runners a plant will send out. So, this stirring of the surface and cutting runners must be kept up all summer. If no injury comes to roots or leaves, the plant will be in splendid condition at the end of the growing season. During the cold weather it will remain dormant; and, if subjected to alternate freezing and thawing, it may receive great injury during the winter. Assuming that it comes through all right, growth will commence at the first of spring, and a great crop will be produced in June. At the end of the bearing season the plant is more or less exhausted; and, if a good crop is desired from it the following year, the grower must commence at once to give it a chance. It must develop a new root system, make new leaves and add another story to its crown or stem.

We are in the habit of regarding a strawberry plant as a perennial, and so it is; but the roots, stem and leaves that are active one year are dead a year hence, and new ones have taken up the work. In early spring the roots that were made the fall before are fresh and vigorous, and new rootlets start from them, and perhaps a few new roots start from the crown. This root system is active until the end of the bearing season, and then the roots turn black, and the plant is nearly at a standstill. The leaves that remained on the plant all winter are superseded by others, and even the latter seem to lose their usefulness about the time the roots are retiring from business. These changes are more noticeable in our hot and dry climate than they are in England.

As soon as rain comes after the bearing season, new roots are sent out above the old ones; and, for this reason, it is well to throw up a little soil to the crowns, for new roots will not come out above ground. If all is favorable an abundance of roots and leaves will be produced, and the crown will be built up higher, and the part that was so active in the spring will die. If injurious insects and fungous diseases could be kept off and half an inch of soil added each season, a plant might produce an annual crop indefinitely.

Instead of cutting the runners off, as we do in hill culture, they may be allowed to grow and cover the ground with young plants. This is the way most growers do. While the individual plants are not very large, there are so many of them that they bear a good crop. They, too, need attention after the bearing season if another crop is to be taken.

The Soil

The soil furnishes anchorage for the roots of the plant and a reservoir for food and moisture. So long as these objects are accomplished, it makes almost no difference to the plant whether the soil be light or heavy, sand or clay. The plant lives on the food that it finds in solution between the particles of soil, and not on the soil itself. The reason why one soil is better than another is that it furnishes the needed food and moisture better. "Rich, sandy loam" is said to be the best soil for the strawberry. The truth is that that is the ideal soil for almost any crop. It holds fertility and moisture but is not easily puddled; it becomes sufficiently compact without getting hard or lumpy; and it admits air. These qualities are essential, and they can

usually be had with less labor and care in a sandy loam than in any other soil. Nevertheless, if they be supplied, the strawberry will flourish, all other things being equal. All along the coast, from Long Island to Florida, where the soil is sandy, strawberries are grown to perfection. On the heavy soil at Pittsburg a single grower had over 200 bushels picked in one day, and most of them ran twenty to the quart. The late Chas. Carpenter, of Kelley's Island, raised on a small bed, at the rate of a little more than 600 bushels to the acre, on heavy clay that had not been plowed nor stirred in any way for years. The runners from a bearing bed took possession of an old walk and the next year produced this enormous crop. It is only fair to say that in figuring out this yield, the path from which the berries were picked was included in the area. Some of the largest crops on record have been grown on muck and on the prairie soils of the west. It is hardly probable that any crop we raise—not even excepting grass—is less particular about the soil on which it grows. And the theory that certain varieties can only be grown successfully on clay and others on sand is equivalent to saying that certain breeds of hogs must be fed from a hard wood trough, and others from one of pine. The soil is to the plant what the trough is to the hog—a reservoir for food and drink.

Choice of Location

The strawberry is a cold-blooded plant and is never at its best in a very warm place. For this reason a northern slope is more favorable, other things being equal, than a southern one. If one wants early berries he will choose a sunny location; and, if it is protected on the north by higher ground or by buildings,

so much the better. Land sloping to the west where it receives the last rays of the setting sun is less likely to feel the effects of a frost because it remains warm later in the day and thaws more gradually in the morning. Except in the matter of earliness and lateness, there is little gain in one location over another. Low, black ground where cold air settles and can not get away is apt to be frosty, and should not be used when one has a choice. I have, however, seen excellent crops grown on low, mucky land. By planting late varieties on land with a northern exposure and leaving them covered as late as possible in the spring, and pursuing the opposite course with early ones, the season may be considerably lengthened.

Other things being equal, land that has been in grass within a year or two is to be avoided, on account of the probable presence of white grubs in it. So, also, is land that has been in strawberries within a year to be avoided if it can be done readily, as it is liable to contain insect enemies or rust spores. If the former bed was known to be infested with some enemy, it would better be planted for a year in crops that require constant working. Where one has land which has been heavily manured for a former crop, it is preferable for strawberries to similar land to which the manure is to be applied shortly before the plants are set. Strawberry land should, if possible, have good atmospheric drainage, that is, it should have lower land near it so that the cold air can run off into the low places. On this account blossoms will frequently be unhurt on plantations near a deep valley, while on equally high land further back from the valley, they will be killed by a late frost. Steep land which is subject to washing is, however, undesirable, though the atmospheric drainage be perfect. Land for strawberries should always have good water drainage, either natural or artificial.

The best results cannot be secured where water stands for weeks within a foot of the surface, during the growing season. Whether this water is to be removed by surface drainage or by underdrains each grower will decide for himself. Few of our crops will endure more water near their roots than will the strawberry, but drainage to the extent of removing standing water from the surface or near it must be secured. During the winter while the plants are dormant, the bed may remain under water for two months without injury, but if the water stands so near the surface that the soil is not only damp but wet, the plants are very likely to be lifted out by the freezing. If there is a low place where water stands on the bed during the winter, the plants under water will be uninjured, while those near the margin of the pond will be pulled out. For this reason the ground must be graded so that no water will lie on any part of the bed.

Influence of Trees

People are not generally aware that large trees in or near a strawberry bed are very injurious on account of the water that they draw from the soil. It has been proven that a large tree standing alone in a field will draw from the soil and evaporate into the air from forty to sixty barrels of water every bright day in the growing season. Perhaps the elm is the most injurious, as it sends its roots so far. A tree of this kind has been known to send its roots 400 feet. As most of these roots are below the reach of the plow, and as plants get their supply of water mainly from below, instead of from above, we can easily see why it is so expensive to have trees near to a strawberry bed. In many of our towns the gardens are nearly ruined by the trees growing in the streets. All such trees should have their roots cut just inside of the front fence, compelling them to get their living in the street, which they are well able to do.

Preparation of the Soil

Plowing or spading deeper than is required to cover any growth of weeds or grass that may be on the ground is usually unnecessary and often injurious. If done in the fall there may be an advantage in rather deep plowing to enable the soil to take in all the rain that falls, and in that case it will settle during the winter. This settling is very important. Deep plowing in the spring, unless it is followed by very thorough harrowing, so that nearly every foot of land is tramped, is not best. The best soil should be left on the top. Loosening the soil to a great depth *so that the roots of the strawberry can penetrate it* is labor lost. No soil is ever too firm for the roots of the strawberry, or any of our fruit bearing plants, to penetrate, if it is damp. Roots never work in dry soil. Care must be taken to prevent cavities in the soil, for if there be one of any size under a plant no blossom buds will be developed. Some years ago I planted an acre of strawberries on land that had been used for a pasture for fifteen years. It was a tough blue-grass sod, and in plowing there was a hollow place left under each furrow. A year later when the plants were in bloom I found that all the runners that had rooted over a cavity failed to bloom. I set out about a quarter of an acre of these barren plants, and grew them in hills. The next year they fruited abundantly.

The ideal preparation is first to drain and grade the bed in the fall. Then cover the surface with manure according to its needs. Fresh, strawy manure is as good as any. Early in the spring rake off all trash and make fine to the depth of six inches, and then harrow until smooth, when it is ready for planting. This may seem contrary to the teaching and practice of some

of the most successful growers. Mr. E. C. Davis, of Massachusetts, who grows berries as large as big lemons, and has taken more money as prizes than any other man I know of, makes his soil so fine that he can thrust his arm into it up the elbow. His soil is deep, and by making it fine it soon becomes compact and wherever the roots extend they are in close contact with rich earth. The roots extend by adding one cell to another, and growth follows the direction that furnishes the most food with the least resistance. For this reason if the soil contains lumps or cracks they go between the lumps and in the cracks, and are never in close enough contact for the best results. If the soil is firm, the roots penetrate it in all directions and absorb the needed food and drink. A machinist can drill a fine hole through a block of iron or steel, but never through a keg of nails. To get water out of a damp sponge one must squeeze it.

Fertilizers

The strawberry is like all other fruit-bearing plants in that it reaches perfection in proportion as its wants are supplied. Years ago it was quite common to read of immense crops that had been produced on very poor soil. It is now conceded that good soil is necessary for the best results, or that plant food be supplied. A crop of strawberries removes almost no fertility from the soil; but the plant is made up of rich material, and it needs plenty of fertility to bring it up to a bearing condition. It is hardly necessary to say that stable manure contains all the elements that any soil needs, and, if enough of it can be had, it is rarely necessary to buy commercial fertilizers. There are cases, however, where the latter must take the place of stable

manure. In such cases any good, complete fertilizer will answer. One made from potatoes is about right: I usually scatter it along the row between the plants—not on them—within a few weeks after they are planted. The amount to use must be determined by the grower. A ton to the acre will do no harm, but I would not use so much at one time. If the ground is known to be very poor, half a ton to the acre might be applied, and the same amount in September. Half this amount is usually ample, but it is best to use enough, for the cost of the fertilizer is but a small part of the total expense, and it may double the crop. If one has any doubt about the fertility of the land, in the spring just before the plants come into bloom, a few hundred pounds of a good fertilizer applied to an acre will help wonderfully. If the intention is to plow up the bed after bearing, 200 pounds of nitrate of soda to the acre when about half the fruit has set will add to the crop and to the luxuriance of the plants. It is a great stimulant, and may cause the plants to be more subject to fungous diseases. I am satisfied, from long experience, that a good coat of manure applied in the winter is one of the best methods to get a good crop of strawberries. Lime should never be used on land for strawberries, nor a very great amount of unleached wood ashes. Forty bushels to the acre is ample, on sandy soil, and clayey land needs still less.

Time to Plant

While the strawberry may be set "any day in the year except Sunday," all seasons are not alike favorable. Here in the north, perhaps ninety-five per cent. are planted in the spring. Whatever advantage there may be in delaying this work until later in the season, so as to save a certain amount of cultivating

and hoeing, and to have newly plowed ground that has not been packed by the spring rains, it is a fact that plants may be moved with less injury when they are dormant, or nearly so, than at any other time. In early spring plants are full of stored-up vitality, and a season of rest has fitted them for vigorous growth as soon as the temperature of the air and soil will permit. As soon as growth commences this stored-up substance is drawn upon to produce new roots, leaves and blossoms, and it is almost impossible to take up plants that have made new rootlets without doing more or less injury. Not only this, but there is a loss of valuable time. Whether the plants are set out to bear or to grow plants from, they need every day of the growing season to complete the year's work.

Sex in Strawberries

Strawberry blossoms must be pollenized, or fertilized, before fruit can be produced. This is accomplished when the pistil has reached a receptive condition and pollen has been brought to it, either by the wind or other means. The pollen is produced by the stamens, in great abundance. It is generally conceded that pistillate varieties have no stamens and can produce no pollen; but most of the so-called pistillate varieties do have a few stamens and are to a certain extent self-fertilizing. Of course if a blossom is strictly pistillate it has no stamens and produces no pollen. Whether any variety is entirely without stamens is a question, but growers can not afford to take any risk. The safe way is to assume that all so-called pistillate varieties need a bi-sexual or perfect flowering sort near by. Bi-sexual or perfect-flowering varieties vary greatly in their ability to produce

pollen. Some are strongly staminate and others nearly pistillate. Not only this, but some varieties, like the Gandy, have a few of the earlier blossoms pistillate and all the others bi-sexual. While a perfect berry is evidence that fertilization took place, an imperfect berry, commonly called a "nubbin," is no proof that the pollen was in any way deficient. Imperfect berries may result from a lack of pollen, from any circumstance that prevents the pollen from reaching the pistil while in a receptive condition, or from any injury to a part of the pistils in any blossom. It is difficult for blossoms to get fertilized in a rainy time. The pollen is washed to the ground, insects cannot carry it from flower to flower, and the sticky, honey-like substance on the stigma may be washed off, so that the pollen grains will not adhere. If a part of the pistils in a blossom are destroyed by some insect, and the rest pollenized, a misshapen berry will result.

These are only possible contingencies. The rule is that pollenization shall take place, and exceptions are rare. No crop that we raise is more certain—not even grass. Many growers give themselves unnecessary anxiety in regard to this matter. They think that a mate for a pistillate variety must come into bloom the same day, that it must be within a few feet of it, and that it must be "congenial." Now it is well known that a pistillate blossom will remain in a receptive condition—waiting to be fertilized—for some days. During this time pollen may reach maturity in stamens of a later blooming variety. No person can tell how far pollen may be carried by the wind or by insects. About forty years ago I was shown about half an acre of pistillate strawberries with not another bed within a quarter of a mile. I told the owner that he would have no crop, the plants being

then in bloom, and every blossom pistillate as far as I could see. A month later I was in the same bed and found one of the best crops I had ever seen. A few wild berries in a pasture near by must have furnished the pollen, unless the plants in the bed were able to do it.

It is not uncommon for a bed of pistillate plants to be pollinized by perfect-flowering varieties in another garden near by. I have never yet seen a case where a pistillate variety refused to be fertilized by any bi-sexual variety that was near by and bloomed at the same time.

Growers use more and more bi-sexual varieties among the pistillates. Years ago every seventh row, or even every tenth row was considered sufficient. Now many plant every third row to a perfect-flowering sort. It is likely that if every pollen grain went where it would do the most good, one perfect-flowering blossom could fertilize several hundred that are pistillate.

If some of the first blossoms fail to get fertilized the loss is not so great as one might think; the later ones will have all the better chance, and may offset the loss to a great extent.

Selecting Varieties

This is a subject on which it is not necessary to say much. In the first place a grower should have as definite an idea as possible what characteristics he desires in a variety. If he is a beginner his safest course is to plant varieties that are recommended by other growers in his immediate vicinity, whose methods of culture are the nearest like those he proposes to follow. Next to such varieties the safest are the standard varieties, which have been well tested and have the reputation of

doing well everywhere. The leading characteristics of these varieties are vigor and reliability. If one is seeking to grow the finest fruit possible, it is frequently necessary to sacrifice these characteristics to some extent in favor of size, appearance or quality, as few, if any, varieties combine all the good points. Knowing just what he wants, the grower can, by examining the catalogues of plant growers, find such kinds as purport to be what he desires. He should get a few plants of these varieties and test them for himself. He will be disappointed often, but there is no other way to get the best. A person must always remember that nobody else can do his testing for him, as in no two cases are the conditions the same; and, with changed conditions, comes changed results.

Heeling In

It sometimes happens that a person cannot plant just when he wants to. Wet weather, other work, insufficient help or other obstacles may prevent, or plants may arrive from a distance before one is ready for them. In such cases it is most advantageous to know how to "heel in" plants. Heeling in is merely setting plants close together in a temporary bed.

My way of doing it is as follows: I choose a small piece of ground, somewhat sandy if obtainable, but well drained at any rate. This I spade and pulverize thoroughly, and rake the surface smooth. Beginning at one side, I spat with the back of the spade a strip one spade wide where the first row is to stand. I then cut a trench with the spade through the middle of this strip from end to end, the bank being at an angle of 45 degrees with the surface. The plants are then laid against this sloping

bank, about an inch or two apart, the crowns level with the surface, and about one inch of earth is pressed firmly against the roots. The trench is then filled up, spatted with the spade, and another trench is made about six inches from the first row for the second row.

In this way I have often heeled plants in when the ground was frozen an inch or two deep. I did this work in the morning before the crust had thawed, lifting the crust in large pieces with a pick. The ground underneath is found to be in fine condition, the water having been drawn up into the crust. When plants are heeled in at such a time, they should be immediately covered with straw or other litter to prevent their freezing and thawing.

Plants heeled in in the spring may be left till June, if necessary, and then planted, care being taken to lift as much of the earth that adheres to the roots as possible. Plants received late in the spring, in midsummer or in bad condition are much better to be heeled in and shaded and, if necessary, watered for a couple of weeks before being permanently planted.

Methods of Culture

Strawberries are grown in hills, matted rows or some compromise between these two methods. In hill culture the plants are set as close as they are expected to stand, and every runner is cut off as long as the bed is kept. The common plan where horse labor is to be employed is to have the rows three feet apart, with the plants one foot from each other in the row. This requires 14,520 plants to an acre. For a small bed for home use, thirty inches between the rows gives room enough. If

runners are cut faithfully as soon as they appear, plants grow to a large size, develop many crowns and produce a large amount of fruit. The important point is to cut the runners *before* they exhaust the parent plant. It is generally conceded that the finest fruit is grown by this method.

When grown in matted rows the plants are set much farther apart and allowed to run all they will, the crop being produced on the young plants. It is usual to have the rows four feet apart, and the plants from one to two feet from each other in the row. At the end of the season most of the surface is covered with plants. Some varieties are such plant makers that they should be planted farther apart, or be thinned out.

Mr. T. B. Terry, the well-known agricultural writer and lecturer, who lives in this county, raises berries in matted rows, but at the last of September he narrows up the rows to about two feet, and then thins the plants to six inches apart. This is a very great improvement, and the results are even more than one would expect.

There is another grower in this county, Mr. D. Sherbondy, who has such remarkable success that his berries bring fully twice the average price, and the demand exceeds the supply. He sets his plants thirty inches apart each way, and cultivates both ways until July. Then each plant is allowed to send out four runners, two of which are layered on each side and in the row. In two or three weeks these are rooted, and are then cut loose from the old plant. After that no runners are permitted to grow, and the most thorough cultivation is given. Another grower in eastern Ohio, whose method is substantially the same, has grown four hundred bushels on one acre.

I will speak of one other method that has been very satisfactory: Plants are set out early in the spring, in rows three feet apart, and the same distance from each other in the row. Then a hill of early potatoes is planted between each two plants. The plants are not allowed to run until July, and about the same time the potatoes are dug. Then runners are trained along the row until a sufficient number are rooted, and all others are cut off until the end of the season, or they may cover the whole surface if wide matted rows are desired. The cultivation given to the potatoes is sufficient for the plants, and the strawberry bed is provided for at very little expense.

Where land is scarce, any early crop that comes off about the first of July may be grown among strawberries.

Marking Out the Ground

After the ground has been put in perfect condition and made smooth with the float, or clodcrusher, it must be marked out. There are many ways of doing this, but I will describe only one, which has been very satisfactory to me. One straight, sharpened pole is necessary. Commence at the corner of the patch by setting up the pole at the end of the first row. Then go to the other end of the same row and stand with the right foot on the row, with the eyes looking at the pole. Then find some object beyond the pole—a tree, fencepost or stump—at which you can look, keeping the pole exactly between it and your eye. With these two objects in line, walk towards the pole, making a mark with the sole of the right foot, which is not to be lifted from the ground but only pushed along on the surface. It is necessary to stand up straight, and keep the eyes on the pole.

When the first row is completed, move the pole over and walk to the other end to make the second row. You can make more speed by having two poles, and making rows each way, one with the right foot and the other with the left. If you attempt to make rows both ways with the right foot, they will not be at a uniform distance apart.

If a line be used instead of a mark, it is to be drawn tight six inches from where the row is to be so as not to have it in the way of the spade in planting. By setting the side of the spade near the line, the plants can easily be placed at a uniform distance—six inches—from it.

Planting

The strawberry plant, like any other perennial, has a certain amount of vitality stored up at the end of the growing season; and, if necessary, it can draw upon its supply when growth starts in the spring. In this respect it is like a bulb or a tuber, and will bear a great amount of neglect or abuse, and still grow. As the season advances this stock of vitality is diminished, and more care is required in transplanting. I have taken up plants late in the fall and wrapped them in damp moss and left them laying on the ground where they were frozen and thawed several times during the winter. In the spring they were planted, and they fruited in June. I have even taken up plants while dormant and cut back their roots to half an inch, and they grew and fruited. If plants receive no injury while out of the ground and are transplanted with reasonable care, they are just as likely to grow as are potatoes or onions. A plant may fail from being dried while out of the ground, from being kept too long in wet

moss in a temperature high enough to cause growth, from being planted too deep, or from not having the soil pressed firmly against the roots.

While a strawberry plant holds on to its roots and leaves through the winter, they are not so essential in planting, in early spring, as many suppose. If all the leaves and nearly all the roots be removed it appears to make no difference. If the plant is to be dried while out of the ground, the fewer leaves there are to pump the moisture out of the crown the better. In planting in early spring it is an advantage to shorten the roots. They spread out better, and new roots are more likely to come out of the crown above the old ones. Here is our method which is the best we know of: The plants are taken up with spading forks, put into wet sacks and carried to the cellar, where all dead leaves and runners are removed. The roots are shortened to three inches and the plants are put into shallow boxes and covered with wet sacks. They are then carried to the field and perhaps two hundred taken out at a time and put right end up, in a pail containing a few inches of water. Two men, or a man and boy, work together, one carrying the pail and the other a bright, sharp spade. The ground being marked out, the spade is set squarely across the mark and thrust down at an angle of forty-five degrees and then pushed forward until there is sufficient room at the back of it for the boy to place the plant in position, where it is held until the spade is withdrawn and the earth falls back on the roots. Each plant is taken out of the water as it is planted, and the soil adheres to the wet roots. As the man with the spade steps forward to make another hole, he sets his foot over the roots of the last plant, pressing the earth firmly against them. A man and boy can plant five thousand in a day. When

I buy plants at a high price—from two to ten dollars a dozen—I set them out with more care. They are put in water and the place for each one is made very fine with the spade, after which the plant is set by hand with great care. The crown must be on a level with the surface, and damp soil in close contact with every root.

Just here I want to speak of another point of importance. I discovered about thirty years ago that a plant sends out runners only from one side—the side farthest away from the old plant that produced it. A knowledge of this fact may be turned to good account in planting, for there is an advantage in having all the plants in a row run in the same direction. It is an advantage to cultivate in the direction the plants are running, so as not to throw the young runners out of place. Moreover, the row is more uniform. When two plants in a row run towards each other, the young plants are too thick. If they run from each other, there is a vacancy. Each plant sends out its runners from the side opposite to the runner that produced it. Even if the old runner is cut or broken off, one can easily tell where it was attached to the plant, and no runners will come out on that side.

Cultivation

The main object of cultivation is to prevent the escape of moisture from the soil. Incidentally it prevents the growth of weeds. It has been ascertained by careful experiments that twenty-five tons of water are evaporated from an acre of bare, uncultivated land every bright day during the growing season. This is a tremendous waste, and most of it can be prevented by frequently stirring the surface to the depth of two or three inches,

This stirring produces two or three inches of fine soil, through which moisture from below cannot pass. As soon as rain falls this loose surface becomes packed, and in the right condition to absorb moisture from below and conduct it to the surface where it is carried off by evaporation. For this reason the surface must be stirred as soon as possible after every rain. Even if no rain comes, the water from the firm soil underneath will moisten this loose soil and soon put it in a condition to conduct the water to the surface where it is carried off in vapor. When there is too much water in the soil it is sometimes best to let some of it escape from the surface by leaving the ground firm.

It is well known that all our crops would be much more abundant if there was plenty of water in the soil at all times. In view of this fact how inexcusable it is to permit the loss of twenty-five tons in a day. This is equal to a rain fall of one-fourth of an inch—nearly two hundred barrels. This amount of water cannot be obtained in any other way at so little cost as to stir an acre with the cultivator.

Cutting Runners

First growth, then productiveness, is the rule with all fruit bearing plants, and the strawberry is no exception. It produces its fruit on plants that made their growth the year before. If the conditions for vigorous growth were supplied the plant will continue to grow and make runners rather than develop fruit buds. If the grower wants fruit instead of plants, he endeavors to prevent superfluous growth by cutting off the runners, just as the grape grower cuts off the laterals to cause the vine to develop fruit buds. Now it makes no difference how this work is done if it only be attended to promptly, before the runner has in any

way weakened the plant. The runner is produced at the expense of the plant until it becomes rooted and is self-supporting. Various contrivances have been invented to do this work with little labor, but most of them are faulty in one or more ways: they fail to cut the runners early enough, or they cut some of the leaves. A boy with a sharp knife can do the work well.

Winter Protection

Strawberry plants are liable to be injured in the winter by alternate freezing and thawing. This renders a covering of some kind necessary in many cases. If the soil be of such a character as to hold water, the danger is increased. The injury comes in this way: The water in the soil in being changed into ice expands about one-tenth, requiring that much more room. This expansion is mainly upwards, and the frozen surface carries up whatever may be in its grasp—fenceposts, stones, garden stakes and plants. When the soil thaws it settles back in its place, but the plants do not. The next freezing repeats the process, raising the plant a little higher. This is liable to occur at any time between October and April, and it is just as injurious in November as in March. We have in this case the soil furnishing anchorage to hold the plant in its place, and the freezing to pull it up by the roots. We have all seen strawberry plants, clover and even fence posts lifted six or eight inches in a single winter. If the soil is dry, or nearly so, there is no expansion—no raising up of the surface. A firm soil that holds but little water, and a sloping soil that furnishes good surface drainage expand comparatively little. The same may be said of any soil through which water percolates rapidly, if it is well under-

drained. Level, clayey land that was plowed to a good depth, must be well mulched in order to prevent "heaving." A mulch acts in this way: It prevents the surface from freezing until the water has had some time to get down, and it prevents the sun from thawing the ground on bright days. So long as the ground remains frozen no damage is done, as a rule. If, however, the frost penetrates the soil as far as the roots extend, and the surface is free from snow or mulch, the plants will soon have the sap dried out of them. We sometimes forget that every tree and plant that has any live parts above ground is giving off moisture in winter even on a freezing day. Were it not so, clothes would never dry in a freezing atmosphere. I have seen strawberry beds on gravelly or sandy knolls, where the snow was blown off, nearly killed although not a plant was lifted out. If plants stand so thick as to shade the entire surface they act as a mulch and protect each other. If they are so far apart that a considerable bare ground appears between them, the danger from alternate freezing and thawing is increased. When to put on the winter covering is important. We are often advised to wait until the ground freezes hard enough to hold up a loaded wagon; but there is danger that repeated freezing of the surface may do injury before the frozen ground will bear a heavily laden wagon. The ideal method is to cover the ground at the first freezing weather, leaving the foliage exposed. Then at the end of the growing season, cover the foliage out of sight. It is not a good plan to cover the foliage before the end of the growing season. There is no danger in putting on too much covering if it is removed early enough in the spring—before the plants begin to grow. If the covering is of such a character that the plants can grow through it in the spring, and that is the inten-

tion, not more than three inches should be applied. Mr. Joseph Haywood, one of the most successful growers in Pennsylvania, covers his beds with three inches of stable manure, and lets the plants grow through it. Straw is the most common covering, but any kind of litter will answer. Snow is perhaps the best of all if we were sure of having it.

Early Spring Treatment

If the winter covering is of such a character that it cannot easily be removed, it is common to let the plants grow up through it, and then pull up whatever weeds may come. It is more satisfactory to remove the covering from the bed and keep the surface stirred until it is time to mulch, for the purpose of keeping the fruit clean. Stirring the surface encourages a more rapid growth and will result in fine fruit. Moisture will be retained and the bed will be in good condition for the fruit to reach maturity. If a late frost comes the warmth will rise from the bare ground and help to keep it off. The mulch may be returned just before the fruit commences to ripen. Years ago I was careful not to stir the ground in the spring lest the roots might be injured, but I have had reason to change my mind on that point.

One of the most skillful growers in the country digs up all his plants about the first of November, and heels them in quite close together in frames where they are well covered. Early in the spring they are planted in rows twenty inches apart, and not over six inches from each other in the row. He can do this easier than to clean out the beds of chickweed in the fall, and the yield is good.

Mulching

However widely growers may differ in regard to the management of bearing beds in the spring, it is generally conceded that a mulch is a necessity during the fruiting season. It prevents the escape of moisture at the time it is most needed; it keeps the fruit clean; it helps to prevent the growth of weeds; and it keeps the ground cool. It is to the bearing bed about what cultivation is to the new bed that is being grown for the next season. What is best to use for this mulch must be decided by each grower for himself. Straw is the most common material, and is generally obtainable. I have seen cornstalks, swamp hay, tanbark, lawn clippings and other things used. Sometimes the winter covering is left on the bed to serve as a mulch. Shall the mulch be applied early or late? If put on too early, it keeps the ground cool, retards growth, makes the crop late in ripening, and causes a late frost to be much more injurious than it would otherwise be. The mulch prevents the warming of the soil, and when a frost comes there is no warmth coming up from below to keep it off. Removing the winter covering early and leaving the surface unbroken hastens the warming of the soil and promotes growth. When the first berries are half grown, the weeds may be shaved off and the mulch put on. Leaving the surface unbroken during April allows an immense waste of moisture, but this may be offset by the earliness of the crop.

Treatment of Old Beds

The strawberry is a perennial and under favorable conditions it will bear year after year. Some varieties bear more the second year than they do the first. And yet it has become quite

common to take but a single crop and then plow the bed. This method has its advantages. It prevents the spread of insect enemies, fungous diseases and weeds. It also gives an opportunity to grow a crop after strawberries. Sweet corn, late cabbages cucumbers for pickles, turnips, late potatoes, fodder corn, millet, cow peas and soy beans are some of the crops that may be grown after strawberries.

The best way to treat an old bed depends somewhat on the method adopted before fruiting. If grown in wide, matted rows there is no better way than to mow the bed as soon as possible after the last picking. In a day or two the leaves and mulch are stirred up, and as soon as the wind is favorable the whole bed is burned over. This destroys insects and their eggs, fungous diseases and weed seeds, if there are any, and in a few days new growth starts, and not a spot of rust will appear all the rest of the season. It will need the same cultivation that it did the year before. This is substantially the way to care for any old bed. When beds have been given hill culture and a heavy mulch applied, it is just possible that the crown of the plants may be injured by burning. If there is wind enough to do the work quickly, there is no danger; but, to make it perfectly safe, the material to be burned can be raked into the spaces between the rows, or a little earth may be put over the crown of each plant. When a bed has been burned over, comparatively few runners are sent out during the remainder of the season, and the foliage is so perfectly healthy that it is a pleasure to work among the plants.

Fall Planting

The finest berries that it is possible to produced may be grown on plants set in the summer and fall. This has been demonstrated thousands of times, and is generally conceded. Most of the fine exhibition berries that capture the prizes are grown on fall-set plants. Plants set in July and August are usually classed as fall-set. The plan of planting at that season has its advantages and disadvantages. If spring work was so pressing that planting strawberries had to be put off, or if the matter was neglected for any reason, it can still be attend to. Coming soon after strawberry season, one has more interest in the subject. In summer and fall there are vacant places where early crops were grown, and the time between planting and securing the crop is so short that there are no objections to sparing the land. Plants set at that time are usually free from the attacks of insect enemies, and the crop comes off in ample time to admit of replanting for the next year's crop. The objections to fall planting are that plants are not easily obtained, are higher in price, the weather is more liable to be unfavorable, more care and skill are required, and fall set plants are more likely to be injured in the winter if left unprotected.

Unless it is necessary to plow the land for the purpose of burying rubbish, weeds or manure, a thorough stirring with the cultivator to prevent a growth of weeds and retain moisture, is all that is necessary. This should be done as long before planting as possible, and it should be repeated after every rain. If the ground has to be plowed, let it be done early, and the most thorough harrowing should be given, so as to firm the soil.

If a liberal dressing of well-rotted stable manure can be applied it will be a great advantage. It should be stirred in before

planting to save the labor of applying it after. If manure can not be spared, ten pounds of a complete fertilizer may be put on to each square rod in two weeks after planting. It should be scattered along the row, but not on the foliage. This seems like an excessive application, but it must be remembered that plants cannot send their roots a very long distance in search of plant food in the short time they have to work.

If the bed is to stand more than one year the plants may be set in double rows fifteen inches apart, and the same distance between the plants in the row. A thirty-inch space should be left between each two double rows. If only one crop is to be taken, the rows may be twelve inches apart, and the plants ten inches in the rows, with a twenty-four inch space.

Whether to use potted plants or layers will depend on circumstances. The former are more costly, but they are safer in the hands of unskilled persons. If the soil is dry and no signs of rain, I have found it a good plan to make a hole with a pointed stick where each plant is to stand, and fill these holes with water the evening before the planting is to be done. The soil must be pressed firmly against the roots, and even some shade may be necessary. It is an advantage to set the plants so that all the runners will run across the wide spaces, to facilitate cutting them off. Frequent stirring of the soil and cutting off the runners will be necessary until the end of the season. The stirring should not be deep enough to cut the roots, which come near to the surface during the damp, fall weather. If a quantity of manure, no matter how fresh and strawy, could be scattered over the surface between the plants, but not on them, it will protect the roots from the first hard frosts. If this manure or litter is moved up towards the plants, the regular winter covering may be postponed until the ground freezes; but it is better to cover in November.

Potted Plants

Potted strawberry plants have been in use about forty years, and are in great favor with most amateur growers. They are produced during the summer months by allowing runners to root in small pots sunk in the soil near to the plants from which runners are to be taken. If the weather is favorable the little pots will be well filled with roots in two weeks, when they are to be placed close together in frames where they can be watered when necessary. After remaining in the frame a few days they are in good condition to be planted where they are to fruit. In planting them they are to be knocked out of the pots and pressed firmly in the ground, the crowns level with the surface. It is best to have the earth in the pot and that in the bed of about the same degree of dampness. Potted plants are set with almost no risk, even by inexperienced persons, and they should scarcely cease growing. The earlier they are planted, all other things being equal, the more they will bear the following season.

Another excellent method of producing potted plants is to take young runners with roots from one to three inches in length pot them in two-inch pots and sink them in a frame where they may be shaded and watered for two or three weeks. For home use equally good results may be obtained by cutting thick, tough sod into three inch squares, and sinking them, grass side down, and allowing a runner to root in the center of each piece. Soiled berry baskets may be filled with rich soil and used in the same way. While potted plants are very satisfactory to use, it must be remembered that they are more costly than common layers. It is some trouble to pot them, to care for them until sold and to pack them for transportation. The express charges too, are somewhat higher. If left in the pots a long time they become pot-bound and are not so good. They are mostly used in July, August and September.

Transplanted Layers

For summer and fall planting, I have found transplanted layers to be almost equal to potted plants. A grower near Cleveland induced me to adopt this plan nearly forty years ago. Since that time several other growers have "discovered" the method, which is as follows: A bed or frame of nice, loamy soil that will not bake is made fine and level. Into this are transplanted layers that have recently commenced to root. The plants should be three or four inches apart, and the roots spread out in fan shape, and covered with but little soil, and not pressed very firmly. They must be well watered at the time of transplanting and then shaded. They will need some water and shade for a few days or a week, when they will have thousands of new, white roots. The bed is then to be watered thoroughly when the plants are to be taken up, with the soil adhering, and transplanted where they are to fruit.

If the ground is dry, make a hole large enough to hold a pint where each plant is to stand, and fill it with water in the evening, and do the planting the next morning. If some shade is necessary, cover each plant with a handful of lawn clippings, and leave them there until they dry up. By that time the plants will need no shading.

Raising Plants from Cuttings

It is sometimes very convenient to raise plants from cuttings, and it is easily done. Cutting plants bear transplanting remarkably well, having been thrown on their own resources when roots first appeared. My method of growing them is as follows: It is best to have a frame for this work, and it is made in the simplest manner, out of six inch fence boards. Commonly it is

four by sixteen feet and is covered with cotton cloth. The soil inside is made fine and level, and that on the outside is slightly banked up against it to hold it in place, or else the frame is sunk an inch or two. The runners are cut in the morning when the dew is on, but this may be done at any time by putting them in a wet sack. They are then carried to a sheltered place, made into cuttings and dropped into a pail of water. They are of the right age when roots are beginning to come out. About an inch of the runner is left to each node, and it is often necessary to remove a part of the foliage lest the little cutting dry out before roots are formed to support it. The earth is supposed to be of such a character that it will not bake, but I have grown them in heavy soil, mostly clay, by covering it to the depth of half an inch with sand. It is well watered and then the cuttings are placed in position with the runner stuck into the soil until the node, where the roots are coming out, is resting firmly on the surface and slightly below the level. Perhaps three by three inches is as good a distance as any. If the work is done when the sun is shining, the cuttings must be shaded at once and left covered until sundown. If done after sundown they may remain uncovered until most of the dew is dried off next morning. They will need shading most of the time the sun is shining for a few days until they get roots. Each morning they remain uncovered a little later, and the shading is removed earlier. In cloudy and rainy weather they need no shading, but it may be necessary to leave them covered in a windy time, night or day. In a dry time the frame may need watering night and morning for the first few days. Later, one watering in the morning is sufficient. If carefully attended to, the plants will be rooted in ten to fourteen days. They may then be planted where they are to fruit, or they may be potted for sale, or planted in beds to be sold as layers later on. The cuttings should be planted immediately after they are cut, if possible. If left in water a few hours before planting, they are likely to die.

Insect and Fungous Enemies

As I do not pretend to be a scientist I have been obliged to borrow the most of what follows,—mainly from reports of experiment stations. These descriptions will assist growers somewhat in identifying enemies, but I would strongly urge all who find pests with which they are not familiar, to send specimens of them and the affected plants to the experiment station of their own state, where they can get reliable information and competent advice.

INSECT ENEMIES

WHITE GRUB (*Lachnosterna fusca*).—This, the most serious insect enemy of the strawberry, is described by Miss Murtfeldt, of Missouri, as follows: "Its length is about one and a half inches and its thickness that of the tip of one's little finger. The head and collar are horny and brown and there are six long sprawling legs on the thoracic joints. Its most distinguishing feature is the enlarged, smooth, bulbous hinder end, through which the soil which it swallows with its food shows darkly. This is its appearance when nearly ready to transform after, it is supposed, three years of larval growth and when it is the most destructive."

The worst feature of this pest is that one never knows where it is until it has destroyed plants. It is generally supposed that it is most prevalent in land that for several years has been in grass, but this is not always the case. I believe that it is more likely to be found on knolls and hills than in low ground, and near trees than in the open.

The parent of the grub is the common May beetle or "June bug," which is so prevalent in those two months, buzzing about

lights at night. The grub, after being hatched, is small and lives in the ground for three years, growing larger each season, until it transforms and becomes a beetle. It is a mistake to suppose that ground containing small grubs is a safe place in which to plant strawberries. These are the most dangerous, as they still have a year or two in which to live and eat, while the work of the larger ones underground is almost finished. A large one is far more destructive than a small one for one season, however.

The presence of a grub under a plant is detected by the wilting of the small, tender leaves, the larger ones still continuing to remain apparently fresh. A gentle pull will generally bring the plant up with about half an inch of roots attached to the crown, the grub having eaten them off at that point. By shaving the ground off carefully with a hoe, the grub will frequently be found. This should always be done, otherwise it will probably destroy several more plants. There is no way of saving the plants except by killing the individual grubs, so far as I know.

To avoid trouble from grubs there are some methods of more or less avail. In the first place, it is better to set strawberry plants on land that has been "hoed crops" for two, or better, three years. If this cannot be done, land that has been in rank red clover is generally less to be feared than that which has been in grass. Deep plowing very late in the fall is believed to kill many grubs.

Several mechanical devices for destroying May beetles have been tried. The principle of all is to attract the beetles by a light at night and, when they fly against an obstacle and fall, to catch them in a vessel containing water and a little kerosene. It may be a lamp set behind a window with a trough fixed to the window-sill outside, a lantern set over a tub, or other device. It is urged against all these that they kill many friendly insects.

If early potatoes are planted among strawberries, the grubs will be found largely in the hills of potatoes and may be killed at digging time.

STRAWBERRY CROWN-BORER (*Tyloderma fragariae*).—This was quite fully described by Prof. Wm. B. Alwood, now of Virginia, in the report of the Ohio Station in 1887. He describes the adult as a small beetle, three-sixteenths of an inch long, deep chestnut brown, a member of the curculio family. It lays its eggs on the crown at the base of the leaves, probably in April or May. The young grub, when hatched, eats its way into the crown, where it spends its whole life tunneling through the crown and destroying the plant. The beetle emerges in August or early fall. The best preventive lies in washing plants before setting, planting only on ground on which strawberries have not been grown for a year and at a distance of a few rods from any other strawberry bed. Burning old beds over after fruiting is good. When plants are found infested they should be dug up and burned. The beetle cannot fly and will not go far unless carried.

STRAWBERRY ROOT-BORER (*Anarsia lineatella*). Mr. H. N. Starnes, of the Georgia Station, calls this the "crown miner." He describes it as a "a minute reddish caterpillar, larva of a small dark-gray moth, completely riddling the crown and larger roots by tunneling in all directions through them." Professor Alwood says that the affected plants are almost sure to die in the fall, but, if they live till spring, they will be useless. The remedy is rotation and digging up the affected plants and burning them.

STRAWBERRY ROOT-WORM.—This is called by Mr. R. H. Pettit, of the Michigan Station, the "strawberry root-borer" but

is different from above. Its scientific name is *Typophorus cancellus*. Mr. Pettit describes the full-grown beetle as "yellowish brown with four black spots upon the wing covers. The prothorax and head are colored reddish brown. The beetle is about one-eighth of an inch long. The larva or grub is of about the same size and resembles the common white grub except in size. The adults hibernate under rubbish, appear most numerous in May, lay their eggs, and eat holes in the strawberry leaves until the fruit is picked. The grubs eat the roots.

This pest resembles and is closely related to *Scelodonta pubescens*, which with two others, is described by Professor Alwood. These three are almost alike in grub form, but do their work at different seasons of the summer. They tunnel in the bark of the roots, not often entering the center. Rotation, and the destruction of affected plants seem to be the main remedies.

STRAWBERRY ROOT-LOUSE (*Aphis forbesi*).—This pest is fully described by Prof. E. Dwight Sanderson, in Bulletin No. 49 of the Delaware College Station, issued December, 1900. He describes it as an aphid about one-twentieth of an inch long, deep bluish-black in color and somewhat pear-shaped, tapering toward the head. These lice lacerate the roots and suck out the juices to such an extent that the plant withers and dies or is unable to mature a full crop. "During the winter the small, shiny black aphid eggs may be found thickly clustered upon the stems and along the ribs of the green leaves." They hatch in March and early April. The young lice feed on the leaves at first but soon go down to the tender leaves of the crown. A new brood appears every ten or fifteen days all summer.

About May first ants become numerous in infested beds, making nests under the plants and carrying the young aphids down

from the leaves to the roots, where they take care of them. They are instrumental in spreading them. As ants also care for the corn root-louse and the melon louse, fields in which these crops were grown the previous year, if they were infested, are likely to be full of ants' nests. If such fields are planted to strawberries and root-lice appear, the destruction wrought by them will be the greater. The chief enemies of these aphids are internal parasites. Lady birds and their larvæ also feed upon them.

The best preventive is setting clean plants on clean ground. Land which is infested should be worked thoroughly in other crops for at least a year. Plants should be secured from patches which are not infested or else fumigated with hydrocyanic acid gas. "Plow under old infested beds before May first or locate new beds as far from them as possible. No successful remedial measures are known."

STRAWBERRY WEEVIL (*Anthonomus musculus*).—Mr. Hugh N. Starnes, of the Georgia Station, said of it in 1896, "a small black beetle, sometimes attacks the buds and blossoms of the strawberry, destroying the stamens of the bi-sexual varieties and ruining them both for fruit and for purposes of pollenization. Kerosene emulsion or white hellebore have been suggested as remedies—the plants to be sprayed as soon as the buds are set." Professor Beckwith, of the Delaware College Station, in 1892 reported investigations made by him, in which he found that pistillate varieties were seldom attacked and that the larvæ penetrated the ovary of the blossom, where they remained until the perfect beetles emerged. Their presence in the ovary is manifested by the blasting of the blossom, the pistils turning black.

STALK BORER (*Gortyna nitela*).—The late Dr. Luggar, of Minnesota, said this pest has in some cases devoured the fruit

of the strawberry. When the caterpillars are young they are of a livid hue with bright stripes along the body. No remedy except hand picking is known.

MURKY GROUND-BEETLE (*Harpalus calignosus*).—In 1898 a number of reports of serious damage to the strawberry crop, by an unknown enemy, were made to Professor Webster, of the Ohio Station, from points in this state. By very careful investigations he discovered that this slim black beetle was doing the work. The damage is done by eating the surface and seeds of the berries. The beetle eats at night, and hides in the daytime. So far as I have heard, the injurious work of this beetle has been reported only in Ohio and New York up to the present time.

TARNISHED PLANT BUG (*Lygus pratensis*).—The following is taken from a bulletin on this insect by Prof. J. M. Stedman, by the Missouri Station in 1899: The bug is about one-fifth of an inch long, half as broad, elliptical in shape and somewhat flattened. It varies in color from dark brown, through light brown to yellowish or yellowish green with darker or lighter markings. The head is black or reddish. The under side of the body is lighter than the back. The adults hibernate under rubbish, stones, leaves, etc., come out on the first warm days and commence their destructive work by piercing and sucking the juices from the leaf buds. The females soon lay eggs, which hatch in a few days, when the young and adults attack the flower buds. Several broods are brought out in one summer, which, later in the season, attack the tender shoots and fruits of great number of orchard and garden plants. The bug is very lively and hard to catch except early in the morning. To this bug is ascribed much of the "buttoning" of strawberries.

The best remedy in case of attack on strawberries is *fresh*

and *pure* pyrethrum, mixed with four times its weight of common wheat flour, applied to the plants, with a bellows made for the purpose or Leggett's "Powder Gun," early in the morning when the dew is on and the bugs are not active. Or the pyrethrum may be mixed with hot water at the rate of one pound to fifteen gallons, stirred till it cools, and be applied early in the morning with a spray pump, using a "Bordeaux" nozzle. In either case the leaves must be moved aside with one hand so that the blossoms and young fruit may be reached. Do not use poisons, as they are likely to poison the fruit and will not hurt the bugs.

STRAWBERRY LEAF-ROLLER (*Phoxopteris comptana*)—The following is taken in condensed form from Bulletin 176 of the Michigan Station, prepared by Mr. Rufus H. Pettit in 1898: "The caterpillars are small yellowish or green 'worms,' which feed on the leaves and cause them to curl up tightly into little clumps which are then bound together with a silken web. The caterpillars or larvæ may be found usually by pulling apart some of the curled leaves. They vary in color from pale yellow to quite a decided green, and when full grown are about one-third of an inch in length, slender and gently tapering. The adult winged form, not seen so often, is a very small and delicate moth, reddish brown and dusky in color, with black and white markings and about one-fourth of an inch in length, while the extended wings measure a little less than half an inch." The first brood of caterpillars appear in June, the second late in the fall.

Remedies. For the June crop spray with kerosene emulsion, long enough before the fruit ripens to give the oil time to evaporate. After bearing, mow the bed and burn it over. Then spray with Paris green and lime, repeating as long as any caterpillars appear.

NEAT LEAF ROLLER (*Eccopsis permudana*)—Not so common as the foregoing. The moth is greenish. Mr. H. N. Starnes, of the Georgia Station, says: "The caterpillar is green, with a black head, and very active, attacking buds and flowers, which it draws into its sewed-up leaf to feed upon undisturbed." He thinks that hand picking and burning the plat in early winter are perhaps the best remedies.

SMEARED DAGGER (*Apatela oblinata*)—This is another enemy which attacks the leaves. Mr. Starnes says: "This caterpillar is the larva of a grayish moth. It is black, with red tufted tubercles and variegated with bright yellow spots and bands. Two broods appear: one, during the fruiting season, for which the remedy is pyrethrum powder; the other, appearing in the early fall, may be controlled by Paris green—one ounce to sixty gallons of water."

STRAWBERRY SAW-FLY (*Harpiphorus maculatus*)—First described as *Emphytus maculatus*. "The 'worm' or false caterpillar is a dirty yellow or yellowish naked caterpillar, not quite three-fourths of an inch long. Its head bears three or more brown spots. There are twenty-two legs," says Mr. R. H. Pettit, of the Michigan Station. "Early in May the eggs are said to be laid in slits cut in the leaf-stem of the strawberry leaf. The eggs hatch, and the young false caterpillars attack the leaves." A second brood appears in August or September.

Mr. Pettit says that after the plants have bloomed and before fruit begins to ripen, these pests may be killed with kerosene emulsion, thoroughly applied so as to strike every worm. He thinks air-slaked lime and sulphur or lime alone, sprinkled through coarse bagging on the plants, would kill the worms.

The SPOTTED PARIA (*Paria sex-notata*), STRIPED FLEA BEETLE (*Phyllotreta vitata*) and some others, which I am unable to describe, also injure strawberry plants to a greater or less extent in some places.

FUNGOUS DISEASE

STRAWBERRY LEAF-BLIGHT, Rust, Leaf-Spot, Spot disease (*Sphaerella fragariæ*)—This disease generally manifests itself first in June in a brownish red or red-purple spot, which soon changes to a dead white spot with a narrow red purple or purplish brown border. "These spots often join and form a single large discolored area."

The general conditions conducive to attacks of the rust are a weakened condition of the plant, due to warm, damp weather producing rank growth, followed by hot, dry weather which checks growth; bearing a heavy crop; and age and general weakness of plants; also, hot, damp weather and low, poorly drained land, which are conditions favorable to the growth of most fungi. One writer says that rust is more prevalent on sandy soil than on clay loam.

It frequently causes great damage to a crop by appearing after the fruit has set, weakening the leaves and attacking the fruit-stems and hulls, "cutting off the supply of nourishment from the berries and disfiguring them by the wilting of the calyx." It is generally worst late in the season and sometimes weakens plants so they die during the winter.

Probably the best preventive is to keep the plants, as far as possible, in a vigorous condition by good culture and plenty of food. After fruiting, mowing and burning over the beds will kill most of the fungus; but a better way still is to plow them

under if they are very rusty. The chief chemical remedy is Bordeaux mixture, which may be sprayed on young plants as soon as growth begins and three or four times during the season as may be necessary. The following spring, spray just before blossoming and ten days or two weeks later. Where plants have been heeled in before planting in the spring, this may be done easily while they are in a small, compact bed.

Some varieties are very susceptible to the attacks of rust while others are almost proof against it. In the latter class are found most of the varieties which run rampantly.

Strawberry Culture for Pleasure

Assuming the ground to be very rich and thoroughly prepared, select large, handsome varieties of good quality. About the first of April plant them in rows four feet apart, and one foot in the row, and only one variety in each row. They should receive the best of culture, and have every blossom and runner cut off promptly. If this is kept up till July, the plants will be very strong, and will be sending out great, thick runners. Select two from each plant, and cut them off beyond the first node. One is to be layered on each side of the row, nine inches from the old plant, and placed so that its runners will run towards the next row. These are to be layered carefully *on* the surface—not buried a quarter of an inch. In three weeks, with good culture, they will be well rooted and self-supporting. Cut off the runners close to the young plant, and hoe up and carry off the old ones. This brings you up to the last of July, and the bed is stocked with better plants than could be transplanted by any means, and

each one occupying two square feet of surface—21780 to the acre. With the best of care to the end of the season, and a heavy covering of straw put on not later than November 15th, each plant should yield a quart—680 bushels per acre. This is a high object to aim at, but plants have produced over two quarts at less than a year old.

Growing Exhibition Berries

The difference between a good, well grown berry and one of the immense specimens that are sometimes grown is so great that it is hardly realized. Small berries, such as are often seen in the market, will run from one hundred and fifty to two hundred to the quart. When one hundred will make a quart they are large, and very large when they run from forty to sixty. When large varieties are well grown, a quart basket contains three layers of nine each, and such are readily sold at a good price compared with the smallest that are rated as large. Forty years ago, Rev. J. Knox, of Pittsburg, sold hundreds of bushels of the Jucunda at sixteen dollars a bushel. They were picked in pint boxes, ten berries in each, and retailed at one dollar a box. Mr. Henry Jeroleman, of New Jersey, marketed a great many berries that ran ten to the quart. Mr. John F. Beaver, of Dayton, O., who is one of the most successful amateur growers of the west, has grown handsome berries nine inches in circumference. Mr. A. T. Goldsborough, of Washington, D. C., has grown four-ounce berries. Mr. Joseph Haywood, of Ambler, Pa., has done the same. Last year his berries were not up to the standard, but he had five that made a quart. Mr. E. C. Davis, of Northampton, Mass., is one of the most successful growers in the country.

He has raised berries of perfect form, three inches in diameter and upward.

To accomplish these results two things are necessary; good varieties and good culture. It would be useless to try to grow exhibition berries from any but the large varieties. It is a fact, too, that most of these mammoth berries are produced on young plants of the previous year's growth. Mr. Knox set his plants in the spring, on rich clay soil, eighteen inches apart each way. They received good culture, with hand labor only, and all the runners were cut off faithfully. This is no more than others have done, but in addition to this he covered his beds in the fall with four or five inches of stable manure. Most of this was raked off in the spring, but the soluble plant food that it contained was washed into the soil during the winter, and furnished all that the plants could use in the spring. It also prevented any injury from freezing and thawing.

Mr. Jeroleman pursues a very different course. In September, after digging early potatoes, he plows his land twice, so as to get it very fine and mellow, takes well-grown layers and plants them for the next season's crop. Almost immediately he covers the ground from six to twelve inches on each side of the plants with three inches of stable manure. About December first the entire bed is covered with an inch of salt hay.

Very few people know what can be accomplished by taking up good layers that have been well protected in the winter and setting them in rich, well-prepared soil *early* in the spring. I know one man who was very successful in getting prizes at strawberry shows, and he usually raised his berries from plants set the same season, *early*. This shows that the strawberry plant partakes of the characteristics of a bulb. While it does not

shed its roots or leaves, it may be taken up at the end of the season's growth, after its blossom buds are developed, or before next season's growth begins, and taken elsewhere to bloom and fruit.

Mr. Beaver pursues still another course. His wonderful success depends less on the method adopted than on his faithfulness in attending to the details. When his bed is done bearing it is immediately spaded and prepared for replanting. He prefers to have the ground ready some weeks in advance so as to have time to settle, for he believes in firm soil. A strong point with him is never to let the plant receive a check from the time the runner first becomes rooted until the end of the growing season. To gain this end he is not in a hurry to set out his plants, for it is sometimes difficult to keep plants in full vigor if planted very early, and every runner kept off. A plant rooted in September will produce as large berries as one rooted in July, but not so many of them.

Here is his method: In July strong, healthy plants are selected to take runners from. Only two to four are taken from each plant. They are not potted, but layered in the bed, and are watered while they are rooting, lest they receive a check. When they are rooted they are transferred to the bed with perhaps a quart of earth. They are shaded and watered until established in their new bed. Then frequent hoeing is the rule. Not a weed is allowed to show its head, and every runner is cut off before it exhausts the plant. We would call this good culture, but this is not all. At various times through the summer the spaces between the rows are covered with stable manure, and then thoroughly watered. Perhaps this manure will be drawn up close to the plants the next day, and the spaces hoed. This

process is repeated at intervals, and by the end of the season there is a cushion of this leached manure two inches deep, extending from the plant perhaps a foot into the space. As a result no freezing can reach the the roots until winter weather comes. About the first of December the whole surface, plants and all, is carefully covered with fine hay or lawn clippings. And this is held in place by strips from the planing mill. Early in spring, as soon as growth commences, the covering is removed, and the spaces up to within about six inches of the rows are spaded to a good depth. After repeated trials he has found this to be the best plan on his soil. All weeds are kept down by shallow hoeing until fruit commences to color, when the whole surface is mulched.

Mr. Goldsborough raises his plants from cuttings early in the summer, and transplants them into very hard ground with only a few inches of mellow soil on top. He has had great success with the foreign varieties. He has had Laxton's Commander to weigh four ounces. A piece of ground that had been used as a cattle yard for years and was very rich and as hard as it could be, was covered about four inches with woods earth, and the cutting plants set into it. They received good culture, and were fine plants at the end of the season. With having all the runners cut, each plant developed a number of crowns. Very early in the spring, a part of these crowns were cut off with a sharp knife. This gave the remaining ones an extra chance. From the time the plants came into bloom until the fruit was ripe, they had every attention. Liquid manure was given, and all but one or two berries were removed from each stem. With his method he has never succeeded in raising our American varieties of as large size as the foreign ones.

Mr. Haywood grows strawberries by the acre and has astonishing success. His is neither the hill nor matted row method, but a compromise between the two. He sets his plants in the spring as do almost all commercial growers. Every detail of the work is faithfully attended to. Instead of cutting off all the runners, he selects a certain number from each plant and layers them systematically. From that time on no more runners are allowed to grow. At the end of the season the entire bed, plants and all, is covered with manure about three inches deep. This is never removed, but the plants grow up through it. If any one seems to be unable to get up through the coarse litter, it receives assistance. Growing such fine plants as Mr. Haywood does would insure great success of itself, but covering the bed with such a coating of manure enables him to lead all competitors.

Mr. Davis is a professional man, and raises berries and roses for pleasure. He has probably received more great prizes for fine berries than any other man in the United States. His success has been most remarkable for many years. He tests nearly all that come into the market, but the Margaret is his favorite. It ripens berries every day for four or five weeks, and such berries—as large as good sized lemons. Like all famous growers, he owes much of his success to his great thoroughness from start to finish. Unlike Mr. Goldsborough, Mr. Davis pulverizes his ground until he can thrust his arm into it up to the elbow. He sets out his plants in the summer, after some early crop, and he takes but a single crop from his plants. His success is largely due to his management of the plants during the few weeks previous to the ripening of the earliest berries. As soon as the first berries are formed, two or three are selected on each fruit-stalk, and all others cut off. This would insure great berries, but this

is only the beginning. He still has over a month in which to add to their growth, and he not only pushes the berries by every means, but he prolongs this period of growth as much as possible. Food and water are supplied in abundance, liquid manure being applied every day, and sometimes as often as three times a day. The beds are shaded with paper screens in the heat of the day, so as to prolong the period of growth. Of course he lets most of his plants bear all they will, this pruning being done to obtain extraordinary specimens. He raises a great many three-inch berries without any pruning, and a well-formed berry of that size is simply immense.

Increasing New Varieties

When a grower pays a dollar for half a dozen plants of a new sort he generally wants to make the most of them, so as to have plants the next season for planting, and some for bearing. Several methods may be employed, but the following is as simple as any: Set the plants in a row six feet apart, early in the spring. Of course, the ground should be well prepared and enriched. After planting cover the ground with an inch or two of fine manure for, at least, a foot from the plants in every direction. This will keep the ground moist and furnish plant food. If a strip of ground two feet wide is covered with manure from plant to plant, so much the better. The blossoms must be cut off as soon as they can be. A little later runners will appear, and they too must be cut off. The first runners are weak, and will not make as good plants as later ones. Of course, the surface must be kept stirred. When the plants have become strong and are sending out stout runners, perhaps early in June, train two from

each plant along the row toward the next plant. These are to be layered as soon as they are ready to root. When the row is filled, nip every runner that appears through the rest of the season. If it is desired to raise some plants for the next year's planting, let them be grown from one or more plants at the end of the row. If one wishes to grow a matted row either wide or narrow he can do so, but it might be well in that case to set the original plants three or four feet apart instead of six. In testing a new variety it is well to set a few plants of some well-known, desirable sort, giving it the same chance as the new one gets.

If one has an opportunity to sell plants, and wishes to increase the stock of a new, high-priced sort, there are several methods that may be adopted. When one pays a dollar for six plants and expects to get fifty cents a dozen for the same sort the next year, or perhaps a dollar a dozen within four months, it is a real pleasure to increase the stock as rapidly as possible. I had a friend who raised from one thousand to twelve hundred plants from one in a single season. Here is an excellent method: Set the six plants in a circle three feet in diameter, in such a way that they will run out from the centre of the circle. Place a barrel with holes in the bottom for drainage, in the centre of the circle, and fill it one quarter full of manure—almost any kind. After the plants have become established—say in two weeks—pour several pails of water into the barrel of manure. This will carry down some of the fertility and soak the ground around the plants, causing a rank growth. This is to be done as often as necessary to keep the ground moist—from once to twice a week according to the season. More manure is to be added occasionally so as to keep up the strength of the liquid. The blossoms must be cut off, and every runner layered so that

the young plants may become self-supporting as soon as possible. The surface of the ground must be stirred frequently to prevent a crust from forming. If the earlier runners are potted and planted in a new bed, so that each one may have plenty of room, a large area may be covered in a season.

Another good method is simply to set the plants six or eight feet apart each way, giving good culture and using plenty of liquid manure among the young runners all through the season. One who has never used liquid manure has but a faint idea of what may be accomplished by it. It need not be strong, indeed it is usually better not to be. Even a teaspoonful of saltpeter dissolved in a pail of water will show its effects on plants within twenty-four hours.

Growing Plants

Growing strawberries is one business; growing plants is another. In the former, surplus plants are a by-product, while in the latter it is the fruit that is the by-product. The best place to get plants for a start is from a plant grower; the worst place is from a neighbor's old bed. Other things being equal, it is best to get them from the plant grower nearest home. It is generally better to get them from one who makes a specialty of growing small fruit plants than from a general nursery, especially if in the latter case they are to be sent with trees. I believe it pays much better to have plants sent by express than by freight, even if the charges are high. It must be remembered that in the growing season a plant out of ground is like a fish out of water, every hour brings it nearer death.

When one is growing only a few strawberries, I believe it is better to buy plants each year than to grow them. Where one

is growing them on a large scale, however, he should by all means grow his own plants, unless there is a reliable grower of plants near enough so that he can go and get the plants just when he wants them. When I advise people to grow their own plants I do not by any means intend to convey the idea that they should dig plants from beds grown for fruit. In nine cases out of ten they will dig the little plants in the spaces, which are the poorest on the place. It is very poor economy to set poor plants simply because they are cheap. Furthermore the last plants set on the runners frequently develop no fruit-buds the first season but run more than others; and most varieties run too much for fruit growers anyway. An extensive grower should have a special bed for growing plants. He should set in it good plants, give them good care, watch closely for insect enemies and rust, spray them if necessary, protect them in the winter, and, in the spring, have good clean plants which he can transplant just when the conditions are most favorable, without any delays and with no risk of poor handling and bad packing.

If one desires to plant in the fall, the plant bed should be set in the fall, so that the plants will send out runners early in the summer. In digging plants in the summer and fall there is generally a great waste of plants, part, at least, of which may be avoided, as is explained under the heads of Transplanted Layers and Raising Plants from Cuttings.

Testing New Varieties

Every grower is desirous of getting the best varieties for his purpose, and this is as it should be. The plants are our employes, and their work is to collect the plant food found in the soil and make it into berries. There is a wide difference in the

characteristics of varieties. No two make the same kind of berries, I might almost say that no two growers want the same kind. If one desires the very finest for a discriminating market he will get little satisfaction from small berries no matter how great the yield. If one is content with what he has and refuses to test new sorts, he is liable to see some of his customers go to competitors for the best berries. Some growers are prejudiced against new varieties because they have purchased some that failed to meet their wants. Some are even of the opinion that plant growers are less reliable than are other men. It is not easy to write a description of a variety that will convey the exact truth to others, but it is safe to say that nearly every variety had some characteristics that made it seem worthy of introduction to the originator or introducer; and every grower should be able to tell, from the description, whether it will be worth testing by him. If a grower wants berries for home use, size, beauty and quality are the characteristics to seek; for a near market that is not too discriminating, productiveness is of the first importance; for a distant market, one must have firmness to stand shipping; for exhibition, size and beauty are indispensable. For the farmer who takes no particular pride in berries, but desires to have his family well supplied with good ordinary fruit, with the least amount of trouble, one of the tough, reliable varieties that succeed everywhere and have a long season, should be chosen. It is safer for each grower to test several varieties, and hold on to at least two; for they rarely behave alike under different conditions, and two or three sorts are more likely to give a supply than is a single variety. One should have both early and late so as to extend the season.

New varieties are first offered at a high price, and it is not

expected that any one will buy many to start with, but if one desires to keep up with the times, he can buy half a dozen, and see for himself whether it is an acquisition.

Raising Seedlings

There is great pleasure in raising new varieties from seed. They come into bearing so soon, and it is so easy to combine the qualities of two varieties, one being imperfect or pistillate, and the other perfect or bi-sexual. Suppose that one wants to produce a desirable, very late variety. He could select the Hunn which is the latest of all, pistillate, and somewhat inclined to rust. This would be the mother, or seed-bearing variety. For the male parent he could choose the Joe, which has perfect foliage and is in every way desirable. One plant of each could be planted together in the fall or early spring, away from other sorts, and a few fine berries grown. The outside of the berry, containing the seed, is pared off and mixed with sand and then dried. It will keep at least three years. It may be sown at once and given some shade and water until it comes up, which it will do in from two to four weeks. Some of the seeds will remain dormant until spring. The young seedlings are very small at first, and will need attention lest they dry up or get choked with weeds. As soon as they can be handled they should be transplanted a few inches apart so that they may have room to become stocky. In September they will be ready to be transferred to the place where they are to fruit. They should then receive the same care as is given to fall-set plants. Most important of all, they must be protected in winter. It requires care to raise seedlings in the summer, as a little drying may be too much for them.

A way that I have found far more satisfactory is to mix the seed with some sand and put it in a flower pot, any time from fall till spring, and sink it in the ground and cover with a brick. The north side of a building where the pot will stay frozen is a good place. The pot of sand and seed may be sowed in the open in early spring, just as one would sow lettuce seed. It comes up promptly and there is a whole season for the seedlings to get into good bearing condition for the next year.

Introducing New Varieties

There is, I think, a mistaken idea in some quarters that there is a great deal of money to be made in originating and introducing new varieties. There was once, but that time has passed. In 1873 I sold the Sterling and Margaret (not the present Margaret, but one that long since passed from view) for \$1200. In 1894 I purchased the Wm. Belt from the originator for \$100. Some good varieties that have been introduced on a commission basis did not bring the originator one-half that amount. I believe that disappointment is almost invariably in store for the owner of a seedling, who expects to make a large amount out of it. So well satisfied am I on this point, that I would advise any grower who has a seedling of such value that it gives him an advantage over his competitors, to hold on to it and keep his advantage. However, from long experience, I will give a little advice to those who do not see fit to take the foregoing.

In the first place, be very careful to whom you intrust plants for testing. Many an originator has been robbed of the results of his labor by giving a few plants of his seedling to a friend or neighbor, who sold them to some plant grower who was un-

scrupulous enough to acquire the variety in such a way, or did so innocently. Moreover, it does you no good to distribute plants among your neighbors, unless they happen to be men of reputation in the strawberry world, which is not usually the case, but it is a distinct disadvantage to you if you ever desire to sell the control of the variety, as the purchaser has no assurance that somebody having plants will not put them on the market. The best place to have new varieties tested is at the experiment stations of the various states. There it is done by men who know their business, are perfectly impartial, have large numbers of other varieties with which to make comparisons, and whose reports are accepted as authority and are given wide publicity. It is also well to send seedlings for testing to a number of plant growers and experts of whose integrity one is satisfied.

If, after careful testing by experiment stations and competent judges, a variety appears to be so superior as to warrant its introduction, there are three ways in which to introduce it. The best, in my opinion, is to sell it to some plant grower, if a fair offer is made. The next is to have some person or persons in the trade introduce it on commission, the usual rates being twenty or twenty-five per cent. of gross receipts to the originator, although more is sometimes given, where the variety has been very well tested and has an exceptionally and uniformly good record. The third way is for the originator to introduce it himself. Unless he is a plant man, this is a poor way generally. If one adopts this way, however, he would better use the testimonials of those only whose opinions have some weight. The testimonials of the country paper and the village minister go for nothing, and make a circular look as if really valuable opinions could not be had.



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